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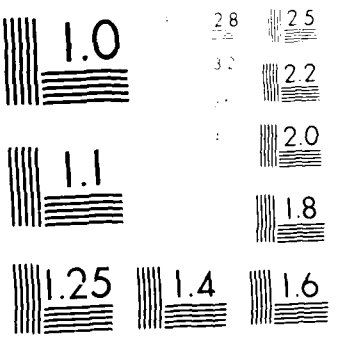
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We studied the effects of 2450MHz circularly polarized microwave irradiation on central nervous system functions. Pulsed (2μs, 500 pps) microwaves decreased high affinity sodium-dependent choline uptake in the hippocampus and frontal cortex of the rat. The effe on hippocampal choline uptake was blocked by pretreatment with narcotic antagonists. Continuous-wave microwaves of the same power density decreased choline uptake in the frontal cortex only. Furthermore, we found that the effects of pulsed microwaves on centra cholinergic activity are classically conditionable to cues in the exposure environment.

The hypothesis that some of the neurological effects of pulsed microwave irradiation are caused by its effect on the auditory system was investigated. Effects of 'pink noise' and 'pulsed microwaves' were compared.

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Progress Report: The main objective of our research is to understand the neural mechanisms involved in the neurological effects of low-level microwave irradiation. Further experimental proof is sought to support our hypothesis that some of the neurological effects of microwave irradiation are mediated by endogenous opioids. In our experiments, rats were irradiated in the cylindrical waveguide system of Guy et al (Radio Sci. 14:63, 1979). Circularly polarized 2450 MHz microwaves at a power density of 1 mW/cm^2 (average whole body SAR 0.6 W/kg) were used. Effects of both continuous-wave and pulsed (2 us, 500 pps) microwaves were studied.

We studied the effects of acute (45-min) exposure on high-affinity choline uptake in the central nervous system of the rat. Choline uptake is an index of activity of cholinergic innervations to nervous tissues. We found that pulsed microwaves decreased choline uptake in the hippocampus and frontal cortex, but had no significant effect on uptake activity in the striatum, hypothalamus and inferior colliculus. Continuous-wave microwaves decreased choline uptake only in the frontal cortex, but had no significant effect on that of hippocampus, striatum, and hypothalamus. Furthermore, we found that the effect of pulsed microwaves on hippocampal choline uptake can be blocked by pretreatment with narcotic antagonists, naloxone and naltrexone, whereas the effect of microwaves (pulsed and continuous-wave) on frontal cortex choline uptake is not significantly affected by narcotic antagonist pretreatment. These data suggest that (1) continuous-wave and pulsed microwaves can have different patterns of effect on central cholinergic functions even though the pattern and amount of energy absorption are similar in both forms of radiation and (2) the effects of pulsed microwaves

on hippocampal choline uptake is mediated by endogenous opioids. The neural mechanisms involved in the effect of microwaves on frontal cortical choline uptake is unknown.

In another series of experiments, we exposed rats to pulsed microwaves in 14 daily sessions (45 min/sessions), and on the 15th day, they were sham exposed. High-affinity choline uptake was assayed in the frontal cortex and hippocampus immediately after exposure. A decrease in choline uptake was found in the cortex, whereas an increase was observed in the hippocampus. These results suggest that the effects of pulsed microwaves on choline uptake in the hippocampus and frontal cortex are classically conditionable. Further experiments suggest that cues in the exposure environment served as the conditioned stimuli. These data support one previous finding that the neurological effects of microwaves are classically conditionable (Lai et al., Psychopharmcology, 88:354, 1986).

Another aspect of our research involves the testing of the hypothesis that the neurological effect of pulse microwaves is caused by their effect on the auditory system (Chou et al, J. Acoust. Soc. Am. 71:1321, 1982). The effect of a 70 db 'pink' noise was compared with that of pulsed microwaves. In previous experiments, we found that acute exposure to pulsed microwaves elicited a transient hyperthermic response immediately after exposure (Lai et al., IEEE Trans. Microwave Theory and Tech. MTT-32:882, 1984). This postexposure-hyperthermia was blocked by treatment with narcotic antagonist and was not observed in animals exposed to continuous-wave microwaves of the same power density. We found that a similar hyperthermic response was elicited in animals exposed for 45 min to 70 db 'pink' noise. The effects of acute 'pink' noise exposure on central choline uptake is being studied.

In future experiments, we will make electrolytic lesions in various locations along the auditory pathways and to investigate whether such lesions can block the pulsed microwave-induced postexposure hyperthermia and changes in choline uptake in the hippocampus and frontal cortex.

Publications and presentation during tnis report period

Lai, H., Horita, A., Chou, C.K., and Guy, A.W. Low-level microwave irradiation attenuates naloxone-induced withdrawal syndrome in morphine-dependent rats. Pharmacol. Biochem. Behav. 24:151-153 (1986).

Lai, H., Horita, A., Chou, C.K., and Guy, A.W. Naloxone blockable, classically conditionable hyperthermia in the rat after microwave exposure. In: Homeostasis and Thermal Stress. Cooper et al (eds); S. Karger, Basel. pp. 174-179 (1986).

Lai, H., Horita, A., Chou, C.K., and Guy, A.W. Effects of low-level microwave irradiation on amphetamine hyperthermia are blockable by naloxone and classically conditionable. Psychopharmacology 88:354-361 (1986).

Lai, H., Horita, A., Chou, C.K., and Guy, A.W. Effect of low-level microwave irradiation on choline uptake in the rat brain are classically conditionable (Presented at the 8th Annual Meeting of the Bioelectromagnetics Society, Madison, Wisconsin, June 1-5, 1986).

Lai, H., Horita, A., Chou, C.K., and Guy, A.W. Microwave irradiation and action of psychoactive drugs: A Review. IEEE Engineering in Medicine and Biology (In Press).

Lai, H., Horita, A., Chou, C.K., and Guy, A.W. Low-level microwave irradiation affects central cholinergic activity in the rat. (Revision sent to *J. Neurochem.*).

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